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DESIGN AND CONSTRUCTION OF A LARGE DYNAMIC ENVIRONMENTAL CHAMBER

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The views and conclusions expressed and the recommendations made in this report are entirely those of the authors and should not be construed as expressing the opinions of Saskatchewan Municipal Government.

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for

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EXECUTIVE SUMMARY

This report summarizes the design and construction of a large dynamic chamber to be used for testing of construction materials and systems. The chamber design is based on a number of existing dynamic chamber test standards including ASTM E1333-90[1] and D5116-90[2].

The chamber has a volume of approximately 23 m^3 and provides full access for testing a broad variety of building materials and equipment. The chamber is completely lined with 304 stainless steel and has a dedicated air supply and exhaust system. The air supply system can provide up to 1.0 air changes per hour of temperature and humidity controlled clean air to the chamber. High efficiency particulate and organic vapor filters provide an ultra high purity air supply capability when required.

This facility is unique in Canada and provides a strategic resource for Saskatchewan to expand its leadership role in indoor air quality research and product testing.

1.0 INTRODUCTION

In response to the growing need for data on the pollutant emission characteristics of building materials and systems, the Building Science Division undertook to construct a unique Canadian facility for evaluating these components.

It is widely felt within the research community that full-scale dynamic tests represent the highest level of characterization of product emissions and represent the state-of-the-art in testing technology.

In response to this need, and as a continuation of work conducted in small environmental chambers, the Building Science Division designed and constructed a full-scale dynamic chamber test facility. Basic characteristics of the facility are:

- A volume of 23 m^3 to allow full-scale tests of systems and components.
- An air handling system to supply a controlled air exchange rate to the chamber. The air can be filtered to 99.97% particulate removal at 0.3 microns and is equipped with organic filters.
- Controlled temperature and humidity.
- Computer-based data acquisition system for recording temperature, humidity, air flow rates and other test parameters.

The interior and associated mechanical equipment is constructed of stainless steel to prevent surface absorption or reaction effects.

2.0 DESIGN CRITERIA AND SPECIFICATIONS

2.1 Chamber Interior Construction

- 16 gauge 304 stainless steel interior (completely welded shell)
- Length: 4.01 m
- Width: 2.67 m
- Height: 2.16 m
- Door Opening: 0.97 m (width) x 1.98 m (height)

2.2 Chamber Exterior Construction

All exterior surfaces are insulated to a minimum RSI 2.1 and exterior walls are covered with prefinished gypsum board.

2.3 Air Supply System

The air supply system consists of the following:

- squirrel-cage blower capable of supplying 0 to 1 air changes per hour of filtered and conditioned air;
- 60% efficiency pre-filter, 90% efficiency secondary filter, plus 99.97% at 0.3 micron HEPA final particulate filter;
- in-line duct electric heater;
- drum type evaporative humidifier; and
- high-performance activated charcoal filter for removal of chemical contaminants (to be installed at a future date).

The air supply is introduced at one end of the chamber through a dual air supply plenum. Exhaust air from the chamber is removed from a dual exhaust plenum mounted on the opposite end of the chamber and discharged directly to the exterior of the building.

Currently, humidification is provided by an inside chamber mounted humidifier, but future modifications will include deionized water/steam injection humidification discharged directly into the air supply system.

2.4 Instrumentation

The temperature is controlled using a YSI Model 72 proportional temperature controller connected to the in-line stainless steel electric heater. Temperatures of the supply air and internal chamber temperature are recorded on a Symetrics Model 8082A computer controlled data acquisition system.

The humidity of the air at the exhaust of the chamber is measured using a Vaisala HPM112A humidity transducer which is connected to the data acquisition system.

Air flow measurements are taken using ductwork traverses from a TSI Model 1650 heated probe anemometer. The output from the anemometer is connected to the data acquisition system. Future modifications include the installation of a NIST traceable dry gas meter to measure the total air supply rate.

3.0 SUMMARY

The chamber has been designed and constructed to provide state-of-the-art capabilities for the measurement of volatile organic chemical, particulate and other product emissions for a wide range of building products and equipment. The basic chamber design allows for a high degree of control and measurement of significant experimental parameters and will provide a valuable and unique resource to the Canadian construction and research community for ongoing studies of product and process emissions.

A series of nitrous oxide dispersion/decay tests are currently being conducted to verify the chamber air movement and mixing patterns.

Currently, there are two major projects scheduled for the large chamber facility. The first project includes a $60,000 research study sponsored by Canada Mortgage and Housing Corporation to evaluate the effectiveness of leaded dust cleanup techniques. The

large scale chamber and high level of environmental control provided by the chamber gave the Building Science Division a unique capability to conduct this high profile research project.

The second project involves full-scale testing of formaldehyde emissions from pressed wood products as an extension to an initial project for conducting small laboratory tests. The small tests were very useful in identifying potential control techniques, and the followup study in the large chamber will allow real life evaluation of full size product assemblies.

BIBLIOGRAPHY

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